AMENDMENTS TO THE SPECIFICATION

In the Abstract of the Disclosure: (Place a replacement or new abstract on a separate sheet)

[0021] The fuzzy audio wireless music system utilizes a battery powered BLUETOOTH compliant transmitter to transmit a coded ~~digital~~ BLUETOOTH communication signal from an existing non-BLUETOOTH analog headphone jack of a music audio player device or source to a battery powered BLUETOOTH compliant headphone receiver without the use of wires. A battery powered ~~digital~~ BLUETOOTH compliant transmitter may include a headphone plug in communication with a standard analog headphone jack on a audio source, such as, laptop and desktop computers, portable compact disc players, portable MP3 players, portable cassette players,...,etc. The battery powered BLUETOOTH compliant transmitter adds a unique user code as defined in the BLUETOOTH standard and transmits it to the battery powered BLUETOOTH compliant receiver headphones where a fuzzy logic ~~detector~~ detection system may be used to enhance decoding performance. ~~decodes only the unique user code to~~ The BLUETOOTH communication FAWM system will allow private listening without interference from other users, and without the inconvenience of wires.

In the Specifications:

Please replace the paragraphs and the beginning of the specification with the following rewritten paragraphs and beginning:

FUZZY AUDIO WIRELESS MUSIC SYSTEM

This is a continuation-in-part of application Serial No. ~~10/027,739~~ 10/027,391 which patent application is pending.

BACKGROUND OF THE INVENTION

[0001] This invention relates to music audio player devices and more particularly to systems that include headphone listening devices. The new audio music system uses an existing ~~device~~ non-BLUETOOTH headphone jack (i.e., this is the standard analog headphone jack that connects to wired headphones) of a music audio player (i.e., portable CD player, portable cassette player,

portable A.M./F.M. radio, laptop/desktop computer, portable MP3 player, and the like) to connect a battery powered BLUETOOTH compliant transmitter for digital wireless transmission of a BLUETOOTH communication signal to a set of battery powered BLUETOOTH compliant receiver headphones. BLUETOOTH is a worldwide wireless standard. Detailed Information regarding the standard is available on the web site www.bluetooth.com.

[0002] Use of music audio headphones with music audio player devices such as ~~radio, tape players, CD players, computers, television audio~~ portable CD players, portable cassette players, portable A.M./F.M. radios, laptop/desktop computer, portable MP3 players and the like, have been in use for may years. These systems incorporate an audio source having a analog non-BLUETOOTH headphone jack to which headphones may be connected by wire ~~and connector~~ .

[0003] There are also known non-portable wireless headphones that may receive ~~A.M. and F.M. radio~~ infrared (IR) transmissions. However, these systems operate with a narrow beam width that requires a point-and-shoot style for reception. ~~these systems~~ They do not allow use of a simple plug in (i.e., plug in to the existing analog audio headphone jack) battery powered BLUETOOTH compliant transmitter for connection to any music audio player device jack, ~~such as, laptop and desktop computers, portable compact disc players, portable MP3 players, portable cassette players and the like~~, such as the above mentioned music audio player devices for coded digital wireless transmission and reception by BLUETOOTH compliant headphones of audio music for private listening to multiple users occupying the same space without the use of wires. Existing audio systems make use of electrical wire connections between the audio source and the headphones to accomplish private listening to multiple users.

[0004] There is a need for a battery powered simple connection system for existing music audio player devices (i.e., the previously mentioned music devices), to allow coded digital wireless transmission (using a battery powered BLUETOOTH compliant transmitter) to a headphone receiver (using battery powered BLUETOOTH compliant receiver headphones) that accomplishes private listening to multiple users occupying the same space without the use of wires.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to FAWM (Fuzzy Audio Wireless Music) systems for coded digital transmission, per the BLUETOOTH standard, of an analog audio signal from any music audio player device with a non-BLUETOOTH analog headphone jack to a receiver headphone, which adheres to the BLUETOOTH standard. ~~using~~ Fuzzy logic technology may be

utilized by the FAWM system to enhance bit detection. A battery powered ~~digital~~ BLUETOOTH compliant transmitter may include a headphone plug in communication with any of the previously mentioned music audio sources ~~laptop and desktop computers, portable compact disc players, portable MP3 players, portable cassette players and the like~~. For reception, a battery powered BLUETOOTH compliant headphone receiver may apply fuzzy logic to enhance bit detection. Fuzzy logic detection may be used to enhance bit detection during decoding of the BLUETOOTH communication signal. The FAWM system ~~converts the audio music signal that may be supplied by the source, into a digital signal. This conversion takes place in the small battery powered transmitter that connects to the headphone jack of the source. The transmitter then adds a unique user code and transmits it to the battery powered receiver headphones where the fuzzy logic detector decodes only the unique user code to allow~~ will provide private listening without interference from other users and without the use of wires.

[0006] These and other features, aspects and advantages of the present invention will become better understood with reference to the following drawings, description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Figure 1 illustrates a schematic diagram representation of the FAWM system;

Figure 2 illustrates a graph of the high and low bit fuzzy logic if-then part fuzzy set according to an embodiment of the invention.

DETAILED DESCRIPTION

[0008] The following detailed description is the best currently contemplated modes for carrying out the invention. The description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention.

[0009] Referring to Figure 1, a FAWM system 10 may include a battery powered BLUETOOTH compliant transmitter 20 connected to a portable music audio player (or music audio source) 80. The battery powered BLUETOOTH compliant transmitter 20 that utilizes a CODEC and BLUETOOTH front end may be connected to the music audio source 80 analog non-BLUETOOTH headphone jack 82 using a headphone plug 22. The battery powered BLUETOOTH compliant transmitter 20 may have a transmitting antenna 24 that may be omni-directional for transmitting a

~~coded digital~~ spread spectrum modulated signal, which adheres to the BLUETOOTH standard, to a receiving antenna 52 of a battery powered BLUETOOTH compliant headphone receiver 50. The battery powered BLUETOOTH compliant receiver 50 may have headphone speakers 54 in headphones 55 for listening to the spread spectrum demodulated and decoded ~~digital~~ BLUETOOTH communication signal. During decoding, fuzzy logic detection may be used to increase receiver decoding performance. The FAWM BLUETOOTH compliant transmitter 20 may digitize the audio signal per the BLUETOOTH standard using a CODEC and BLUETOOTH front end. This BLUETOOTH compliant digital signal has a throughput of approximately 1.4 Mbps that may be as low as approximately 1.0 Mbps. ~~which may be determined by the analog to digital A/D converter sampling rate of 44.1kHz multiplied by 16 bit quantization.~~ To reduce the effects of channel noise, the battery powered BLUETOOTH compliant transmitter 20 may use convolutional channel encoding ~~and interleaving~~. For further noise immunity, spread spectrum modulation, as defined in the BLUETOOTH standard ~~may be~~ is utilized. The battery powered BLUETOOTH compliant transmitter 20 may contain a BLUETOOTH compliant shift register generator, or the like, that may be used to create a unique user code. The unique user code generated is specifically associated with one FAWM user, and it is the only code recognized by the battery powered FAWM BLUETOOTH compliant headphone receiver 50 ~~of that~~ operated by a particular user. The radio frequency (RF) spectrum utilized (as taken from the Industrial, Scientific and Medical (ISM) band), may be approximately 2.4 GHz as defined in the BLUETOOTH standard. And the power radiated by the BLUETOOTH compliant transmitter adheres to the BLUETOOTH standard.

[0010] Referring to Figure 1, the ~~digital~~ spread spectrum modulated BLUETOOTH compliant signal from transmit antenna 24 may be received by receiving antenna 52 and then spread spectrum demodulated per the BLUETOOTH standard, ~~decoded and deinterleaved~~ in the battery powered BLUETOOTH compliant receiver 50 headphones. The battery powered BLUETOOTH compliant receiver 50 may utilize fuzzy logic to optimize the bit detection of the received packet code.

[0011] Each BLUETOOTH compliant receiver headphone 50 user may be able to listen (privately) to high fidelity audio music, using any of the audio devices listed previously, without the use of wires, and without interference from any other BLUETOOTH compliant receiver headphone 50 user. . ~~Because of the fuzzy logic detection technique used in the wireless digital audio system, user separation through code division may be achieved.~~ The fuzzy logic detection technique that may be used in the FAWM could provide greater user separation through optimizing code division in the BLUETOOTH compliant headphone receiver.

[0012] The battery powered BLUETOOTH compliant transmitter 20 sends the audio music

information to the battery powered BLUETOOTH compliant receiver 50 in digital packet format as defined in the BLUETOOTH standard. These packets may flow to create a digital bit stream rate of less than or equal to 1.0 Mbps as defined in the BLUETOOTH standard.

[0013] The ~~user~~ code bits in each packet may also be received and detected by a fuzzy logic detection system (as an option) in the headset receiver 50 to provide additional decoding performance. For each consecutive packet received, the fuzzy logic detection system may compute a conditional density with respect to the context and fuzziness of the ~~user~~ packet code vector, i.e., the received ~~user~~ code bits in each packet. The fuzzy logic ~~detector~~ detection system ~~is the key component to the~~ may enable the battery powered FAWM BLUETOOTH compliant ~~system 10. Because the fuzzy logic detector enables the battery powered FAWM~~ receiver 50 to enhance the bit detection accuracy of the packet code in the presence of noise, which may include other FAWM users. Fuzziness may describe the ambiguity of the high bit (1)/low bit (0 or -1) bit event in the received code within the packet. ~~Note that the~~ The fuzzy logic detection system ~~detector~~ may measure the degree to which a high/low bit occurs in the ~~user~~ packet code vector, which produces a low probability of bit error in the presence of noise. The fuzzy logic detection system may use a set of if-then rules to map the code bit inputs to validation outputs. These rules may be developed as if-then statements.

[0014] The fuzzy logic ~~detector~~ detection system in the battery powered BLUETOOTH compliant headphone receiver 50 utilizes the if-then fuzzy set to map the received ~~user~~ code bits into two values; a low (0 or -1) and a high (1). Thus, as the ~~user~~ code bits are received, the "if" rules map the signal bit energy to the fuzzy set low value to some degree and to the fuzzy set high value to some degree. See Figure 2. ~~Due to additive noise each user code bit (bit energy x) may have some membership to a low and high as represented in Figure 2. Therefore, the if-part fuzzy set may determine if each bit in the user code, for every received packet, has a greater membership to a high bit representation or a low bit representation. The more a user code bit energy, x fits into the high or low representation, the closer its subsethood, i.e., a measure of the degree to which a set may be a subset of another set, may be to one. Note that~~ Note that Figure 2 shows that -1 equals the maximum low bit energy representation and 1 equals the maximum high bit energy representation ~~to illustrate that this design may utilize Manchester encoding/decoding schemes~~. Due to additive noise, the code bit energy may have some membership to low and high as represented in Figure 2. The if-part fuzzy set may determine if each bit in the code, for every received packet, has a greater membership to a high bit representation or a low bit representation. The more a user code bit energy fits into the high or low representation, the closer its subsethood,

i.e., a measure of the degree to which a set may be a subset of another set, may be to one.

[0015] ~~The received user code input bit in each packet may be:~~

~~x(i), where i = 1,2, ..., n is the set of all bits that make up the user code vector.~~

~~X(c), where c = 1, 2, ..., m represents each user assigned a unique user code.~~

~~So user X(1) has bit code [x(1) x (2) .....x(n)] and user X(m) has bit code [x(1) x (2) ....x(n)] which is different from user X(1).~~

[0016] ~~Each x in X may activate a fuzzy "if" rule. The if-part sets may be conditional densities, so the fuzzy "if" rule activates to the degree p[x(i)|X(c)] p[X(c)], which is the probability of the user code bits x given the user vector X multiplied by the probability of X.~~

[0017] ~~The then-part fuzzy rule set may be indirectly dependent on the input bits x in X. The then-part set may be a weighted sum equal to p[x(i)] p[y|x(i), i = 1, 2, ...,n.~~

[0018] ~~Which is the probability of the user bit vector x multiplied by the probability of y given the user bit vector x. Where y may be a number representation to define the correct user headset battery powered receiver 50 given the input bit set x(i), I = 1, 2, ...,n.~~

[0019] The if-then rule parts that make up the fuzzy logic ~~detector~~ detection system must be followed by a defuzzifying operation. This operation reduces the ~~output~~ aforementioned fuzzy set to a bit energy representation (i.e., -1 or 1) ~~single number that determines if the correct~~ that is received ~~user code bits within~~ by the transmitted BLUETOOTH standard packet. ~~have been detected. The defuzzifying operation may be implemented with the modal method, i.e., calculation of the value that has the highest membership in the fuzzy set. With the modal method a strategy of clarity may be applied in the event that some user code energy bit values have equally high membership. The clarity of a fuzzy set may be considered by weighting the conditional densities discussed previously. The weighting determines relative fuzziness of the user code energy bit (x) that gives a measure of the uncertainty of the unique user code vector. As a result, the fuzzy logic detector used in the battery powered headset receiver 50 greatly reduces the unique user code bit error probability.~~ The fuzzy logic detection system may be used in the battery powered BLUETOOTH compliant headset receiver 50 to enhance overall FAWM system 10 decoding performance. ~~The fuzzy logic detector technique, combined with convolutional error detection and correction techniques, may enable the FAWM system 10 to operate in most any environment.~~

[0020] While the invention has been particularly shown and described with respect to the illustrated and preferred embodiments thereof, it will be understood by those skilled in the art that the foregoing and other changes in form and details may be made therein without departing from the spirit and scope of the invention.